

Western Electric Co., Incorporated
Equipment Engineering Branch, Hawthorne

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Issue 3 BT-240071
Appendix 1
6-6-41
Replacing all
previous issues.

THIS APPENDIX WAS PREPARED FROM ISSUE 39 OF DRAWING ES-240071

METHOD OF OPERATION

PANEL SYSTEM
SELECTOR CIRCUIT
DISTRICT AND PANEL LINE FINDER
FOR NON-COIN LINES

39. TEST SELECTOR

In order that the circuit used as a test selector ("M" wrg omitted) will be busy to district test circuit when used for Office or Incoming test. Lead DB to automatic test circuit connected direct to (MB) Relay winding instead of to sleeve of (MB) Jack.

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MH

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~~Issue 3~~
Date November 23, 1940
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issues.

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METHOD OF OPERATION

Panel System
Selector Circuit
District and Panel Line Finder
for Non-Coin Lines

DEVELOPMENT

1. Purpose of Circuit

- 1.1 This circuit is arranged to find the calling subscriber's line and connect it with the various switching apparatus necessary to complete a call.

2. Working Limits

- 2.1 B-1 relay (DC) maximum subscriber's loop 750 and 900 ohms with minimum lead of 10,000 ohms on 21 to 25 volt battery.
- 2.2 B-1 relay (DC) maximum subscriber's loop 1500 ohms with minimum lead of 10,000 ohms on 45 to 50 volt battery.
- 2.3 206L relay (CS) maximum external circuit loop 3415 ohms for 24 volt battery or 8000 ohms for 48 volt battery.
- 2.4 maximum conductor loop for remote control zone registration 2640 ohms, minimum trunk insulation resistance 30,000 ohms, maximum earth potential of ± 20 volts.

OPERATION

3. Principal Functions

- 3.01 To find the proper line and start the sender selector hunting for an idle sender.
- 3.02 To establish talking connection.
- 3.03 To supply talking battery to the calling station.
- 3.04 To select an idle sender.
- 3.05 To connect battery for the operation of the message register in the line circuit on a charged call.

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- 3.06 To connect a busy tone to the calling station, if required.
- 3.07 Operates the selector time alarm or restores the district to normal, depending on optional wiring furnished, if the calling subscriber does not disconnect within a predetermined interval after the called subscriber has disconnected.
- 3.08 Optional arrangement to prevent charging in message register position for first talking position.
- 3.09 Arranged to operate the subscriber's register from impulses received over the trunk from a remote control registration point.
- 3.10 Arranged to operate the subscriber's register once at the beginning of each five minute talking interval (non-zone overtime).

4. CONNECTING CIRCUITS

This district selector circuit will function with:

- 4.01 Line finder sender selector type line circuits.
- 4.02 Line finder sender selector type subscriber's sender.
- 4.03 Office selector circuit.
- 4.04 Panel incoming circuit.
- 4.05 "A" operator's trunk circuit.
- 4.06 P.C.I. local or tandem trunk circuits.
- 4.07 Stuck sender selector circuit.
- 4.08 Selector group register circuit
- 4.09 Selector time alarm circuit.
- 4.10 Motor stop alarm circuits.
- 4.11 Misc tone circuit.
- 4.12 Permanent signal trunk.
- 4.13 District release circuit.

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DESCRIPTION OF OPERATION

5. Starting Line Finder

When the receiver at the calling station is removed from the switchhook various relays in the line trip and start circuits operate and (a) connect battery to the L terminal of the line at the line finder multiple bank (b) connect ground to the ST lead, operating the (LF) relay. The (LF) relay operated, (a) locks on its contact and windings in series to ground on the back contact of the (H) relay, (b) closes a circuit over lead Y operating a relay in the start circuit (c) operates the UP magnet causing the line finder selector to travel upward and hunt for terminals of the calling line, to which battery is connected, as hereinafter described, (d) closes a circuit from ground through the break contact of the (E) relay, to battery through the inner winding of the (CI) relay, operating the (CI) relay.

6. Selecting a Sender

As the line finder selector starts upward, hunting for the calling line a circuit is closed through the L commutator, slightly after the brushes of the selector move off-normal. Ground on the L commutator brush and segment, operates the line finder (E) relay. The (E) relay operated, (a) operates the (MB) relay from ground on its armature through the break springs of the (MB) jack, to battery through the inner winding of the (MB) relay (b) closes a circuit from ground on cam I, make contact of the (E) relay, to battery through the inner winding of the (D) relay, operating the (D) relay (c) opens the operating circuit of the (CI) relay, thus permitting the relay to release if the test brush of the sender selector is making contact with the test terminal of an idle sender. If the test brush of the sender selector is making contact with the test terminal of a busy sender, the (CI) relay locks through its outer winding, contacts of cam S, make contact of the relay to ground on the test brush of the sender selector. With the (CI) relay held operated, the operation of the line finder (E) relay also closes a circuit operating the (F) relay in the line finder circuit and the district selector (STP) magnet. This circuit is traced from battery through the 1,000 ohm winding of the (F) relay and through the winding and break contact of the (STP) magnet, make contact of the (CI) and (E) relays to ground on cam H, thereby stepping the sender selector brushes. If the next

terminal is busy, the (CI) relay remains operated and the sender selector continues to step until an idle sender is found. When the (CI) relay releases, the test terminal of the selected sender is immediately made busy to all hunting sender selectors by ground connected to the test brush from cam H, through the make contact of the (L) relay and the break contact of the (CI) relay. This busy ground is connected until the switch advances from position 1 1/4. The operation of the (F) relay opens the tip and ring leads between the line finder commutator and the district circuit and prevents the district (L) relay from operating and advancing the district switch from normal, if the line finder selector connects to the terminals of the calling line before the sender selector finds an idle sender.

7. Making the District Busy - The (MB) Relay Operated

(a) Locks from ground on the armature and outer make contact of the (STA) relay in the (START) circuit, lead X, make contact, and outer winding of the (MB) relay, to battery on the break contact and armature of the (SL) relay, so that the (MB) relay will not release should the selector return to normal while another call is going through, (b) closes a circuit from ground on the M commutator, make contact of the (LF) and (MB) relays, to battery through the 800 ohm winding of the (F) relay, which operates if the relay was not previously operated, (c) connects ground on its armature to the series circuit through the (MB) relays of the other selectors in the same group, thus permitting the operation, over lead CH of the (CA) or (CB) relays in the start circuit, when all line finder selectors in the group are off normal, (d) opens the circuit over the lead Y, to prevent the (CA) relay from reoperating, (e) transfers the ST lead to the next line finder, which, if busy, transfers the call over the ST lead in the same manner until an idle line finder is found.

8. Relasing the Start Circuit

As the line finder selector continues upward, at the end of the tripping zone, the K brush makes contact with the K commutator and connects ground to lead K, thus releasing a relay in the trip circuit. When the K brush breaks contact with the K commutator ground is disconnected from the K lead, thus releasing the start circuit,

9. Line Finder Finds Line

When the selector brushes make contact with the terminals associated with the calling line, battery on the H terminals operates the (O) relay in the trip circuit and the (H) relay in the line finder circuit over lead H. With the (H) relay operated, a 50 ohm noninductive shunt is connected around its winding, to ground on its armature for the purpose of increasing the amount of current through the 500 ohm winding of the (O) relay in the trip circuit thus speeding its operation. This

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is necessary on account of the very short time period during which the H brush makes contact with the H terminal before the circuit over the H lead is opened by the overflow of the selector. The (H) relay operated, opens the circuit which holds the (LF) relay operated, but (LF) relay does not release immediately on account of a circuit being closed from ground on the "C" commutator brush and segment, to battery through both windings of the (LF) relay in series. The (LF) relay is thus held operated until the brushes are centered on the terminals of the calling line. When the circuit through the C commutator segment is opened, the (LF) relay releases, and (a) opens the circuit through the UP magnet, which stops the selector brushes on the terminals of the calling line, (b) opens the circuit through the 800 ohm winding of the (F) relay so that when the circuit through its 1,000 ohm winding is opened, by the release of the (CI) relay when the district sender selector seizes an idle sender the (F) relay releases, (c) closes a circuit operating the (SL) relay. This circuit is traced from ground on the M commutator break contact of the (LF) relay, make contact of the (A) relay, winding of the (SL) relay, cam T, make contact of the (D) relay, to battery on the break contact of the (DS) relay.

10. The Adjustment of the "C" Commutator Brush

The adjustment of the "C" commutator brush, with relation to the tripped "H" multiple brush, is such that it does not break contact with the "C" commutator segment until slightly after the holding circuit through both windings of the (LF) relay is opened by the operation of the (H) relay when the (H) brush makes contact with the H terminals to which battery is connected. The UP magnet, therefore, remains operated and the selector continues to travel upward until the brushes are carried slightly above the center of the line terminals allowing the locking pawl to enter the notch on the rack attached to the brush support rod. At this time, the holding circuit through both windings of the (LF) relay is opened at the "C" commutator, releasing the relay. The (LF) relay released, releases the UP magnet. The selector then drops into place thus centering the brushes on the line terminals.

11. Advancing the District

The (SL) relay operated (a) connects battery to the S lead thus making the line test busy at the final frame and releasing the trip circuit (b) closes a circuit which operates the district (L) and (CH) relays. The (CH) relay operated, closes a circuit from ground on cam I, break contact of the (CS) relay, make contact of the (CH) relay to battery through the selector time alarm circuit which operates if the switch fails to advance from position 1. The (L) relay operated,

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Closes a circuit advancing the district switch to position 2. As the switch advances from position 1, the circuits through the (L) and (CH) relays are opened, releasing the relays and disconnecting the selector time alarm circuit. In position 1 1/2 to 2, the associated sender is held busy by ground through cams H and C.

12. Completing the Fundamental circuit

With the switch in position 2, the tip and ring leads are closed from the calling line to the tip and ring leads of the associated sender circuit, thus permitting the dialing tone to be transmitted back over the dialing circuit from the associated sender, as an indication that the apparatus is ready to receive the call by the operation of the station dial. The tip side of the dialing circuit is closed from the tip of the line, through the break contact of the (F) relay, cam P, to the tip brush of the sender selector. The ring side of the dialing circuit is closed from the ring lead of the line, through the break contact of the (F) relay, winding of the (DC) relay, cam Q to the R brush of the sender selector. In position 2, the (CI) relay operates thru its outer winding to ground on cam S, and remains operated until the switch advances from position 10. The (CI) relay operated, (a) connects ground through the inner contacts of cam S, to the test brush of the sender selector, thus making the associated sender test busy after the switch advances from position 2, (b) closes the tip side of the fundamental circuit through to the sender and (c) closes the sender control lead 9SC) through cams V and U, to battery through the outer winding of the (D) relay. After the sender functions, the fundamental circuit is established for the operation of the district (L) relay and the stepping relay in the sender. This circuit is traced from ground in the sender circuit through the FT brush, make contact of the (CI) relay, cam L to battery through the 1200 ohm winding of the (L) relay, which operates. The (L) relay operated, locks through its 1200 ohm winding and make contact to the same ground over the FT lead and advances the switch to position 3 from ground on cam M. The 500 ohm winding of the (CH) relay is also connected through cam U, in parallel with the winding of the (D) relay to the SC lead. Should the (CH) relay operate at this time due to a high resistance ground in the sender circuit no useful function will be performed.

13. District Brush Selection

With the switch in position 3, the UP magnet is operated for brush selection over a circuit traced from battery through the winding of the magnet, cam C, make contact of the (L) relay, to ground

through cam M. As the selector moves upward in position 3, carrying the commutator brushes over the commutator segments, the A segment and brush intermittently connects ground to the tip side of the fundamental circuit through cams K and L, holding the (L) relay operated but successively short-circuiting the stepping relay in the associated sender circuit, thus releasing and permitting its reoperation until the proper brush has been selected. When sufficient impulses have been sent back to satisfy the sender the fundamental circuit is opened, releasing the (L) relay. The (L) relay released, opens the circuit through the UP magnet, thereby stopping the upward movement of the selector and advances the switch to position 4. This circuit is traced from ground through cam M, break contact of the (L) relay, cam B, to battery through the R magnet. When two digit senders are used with this circuit, the advance of the sender replaces the high resistance on the SC lead with a 500 ohm ground, thus insuring the operation of the (CH) relay. In position 4, the trip magnet (TMO) is operated from ground through cam S, and the (L) relay is operated and locked to ground on the fundamental circuit previously described, advancing the switch to position 5.

14. District Group Selection

With the switch in position 5, the UP magnet is reoperated and, the trip magnet being operated, causes the previously selected set of brushes to trip when the selector starts upward as the set of brushes trip the finger which was previously operated by the trip magnet. As the selector moves upward for group selection, carrying the brushes over the commutator segments, the B segment and brush intermittently connects ground to the tip side of the fundamental circuit through cam L holding the district (L) relay operated, but successively short-circuiting the stepping relay in the associated sender circuit thus releasing and permitting its operation until the proper group has been selected. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened, releasing the (L) relay which in turn opens the circuit through the UP magnet and advances the switch to position 6. When three digit senders are used with this circuit, the advance of the sender replaces the high resistance ground on the SC lead with a 500 ohm ground, thus insuring the operation of the (CH) relay. With the switch in position 6, a circuit is closed from ground on the line finder N commutator brush and segment through the break contact of the (F) relay, make contact of the (SL) relay, inner contacts of cam O, cam R, to battery

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through the 800 ohm winding of the (L) relay, operating the relay. The (L) relay operated, advances the switch to position 7.

15. Trunk Hunting with Trunk Idle

Should the first trunk in the group in which the selector is hunting be idle, the (L) relay releases as the switch leaves position 6 1/4. When the switch enters position 6 1/2 ground is connected to the sleeve of the selected trunk through cam M, break contact of the (L) relay, cam E as busy condition until the switch advances to position 7 3/4.

16. Trunk Hunting with First Trunk Busy

Should the first trunk in the group in which the selector is hunting be busy, the (L) relay is held operated in a circuit from battery through its inner winding and make contact, cam E to ground on the sleeve terminal of the busy trunk. With the switch in position 7, the UP magnet is reoperated from ground, cam M under control of the (L) relay and the selector travels upward until an idle trunk is found. When the idle trunk is found, the locking circuit through the inner winding of the (L) relay is opened but the relay does not release immediately due to a circuit being closed from battery through its outer winding, cam R to ground through the C commutator brush and segment. When the brushes are centered on the trunk terminals, the circuit through the C commutator segment is opened and the (L) relay releases and opens the circuit through the UP magnet, which stops the selector brushes on the terminals of the selected trunk. The (L) relay released, also advances the switch to position 8.

17. "C" Commutator

The adjustment of the "C" commutator brush, with relation to the tripped sleeve multiple brush, is such, that it does not break contact with the "C" commutator, until slightly after the holding circuit through the inner winding of the (L) relay is opened, by the sleeve brush leaving the busy terminals and making contact with the sleeve terminals of the idle trunk. The UP magnet, therefore, remains operated and the selector continues to travel upward until the brushes are carried slightly above the center of the trunk terminals, allowing the locking pawl to enter the notch on the rack attached to the brush support rod. At this time the other holding circuit through the outer winding of the (L) relay is opened, at the "C" commutator, releasing the relay which disconnects ground from the commutator feed bar, (G) releasing the UP magnet.

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The selector then drops into place, thus centering the brushes on the trunk terminal. During trunk hunting, in position 7 only, the commutator feed ground is supplied from ground on cam M under control of the (L) relay. This is to prevent the reoperation of the (L) relay by the closing of a circuit between the C commutator brush and segment on the overthrow of the selector or as it drops into place.

18. Selection Beyond

As the switch advances to position $7 \frac{3}{4}$, ground through cam E is connected to the sleeve of the selected trunk as a busy condition. With the switch in position 8, a circuit is closed from ground on the armature and make contact of the (CH) relay, through cam O, cam R to battery through the outer winding of the (L) relay which operates, advancing the switch to position 9. In position 9, the tip and ring sides of the outgoing fundamental circuit are closed through the tip and ring terminals of the selected trunk for selection beyond, through the RT and FR brushes of the sender selector, and cams F and G respectively. After selection beyond has been completed, ground in the sender is removed from the SC lead, releasing the (CH) relay, in turn releasing the (L) relay. The (L) relay released, advances the switch to position 10. As the switch leaves position $9 \frac{1}{2}$, the dialing circuit is opened at cams P and Q, in position $9 \frac{3}{4}$ the tip and ring leads from the line finder are closed through cams P and Q respectively to 24 volt battery and ground in the district, holding the (DC) relay operated, under control of the station switchhook. With the (DC) relay operated, a locking circuit is closed for the (D) relay after the switch advances from position 10. This circuit is traced from battery through the inner winding of the (D) relay, make contact of the (DC) relay, make contact of the (L) relay to ground through cam I. The (D) relay is made slow in releasing in order that the connection will not be lost if the switchhook at the called station is momentarily depressed. With the switch in position 10, the sender circuit functions and connects ground to the RT lead, causing the (L) relay to operate and lock through its inner winding over the tip of the fundamental circuit previously described. The (L) relay operated, advances the switch to the talking selection position

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until the relay is released by the operation of the sender circuit. As the switch advances, ground is intermittently connected to the tip side of the fundamental circuit, through cam E, holding the (L) relay operated, but successively short-circuiting and permitting the reoperation of the stepping relay in the sender circuit. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened, releasing the (L) relay. The (L) relay released, opens the circuit through the R magnet, stopping the switch in position 11, 12 or 13, depending upon the class of call. As the switch leaves position 10, the holding circuit of the (CI) relay is transferred from ground on cam I to ground on cam E under the control of the (L) relay. This circuit is traced from battery through the outer winding of the (CI) relay, inner contacts of cam U, make contact of the (CI) relay, cam V, make contact of the (L) relay to ground through cam E. The release of the (L) relay opens the holding circuit through the (CI) relay, disconnecting the sender from the district circuit.

19. Called Party Answers

When the receiver at the called station is removed from the switchhook with the switch in position 11 or 12, reversed battery and ground from the incoming circuit operates the (CS) relay. The (CS) relay operated, closes a circuit from ground on cam I, through cam N, winding of the (I) relay, to battery through the #F contact of the (CHG) interrupter. When the interrupter contact closes, the (I) relay operates and locks on the same ground through its make contact. When the #B contact of the interrupter closes, the operation of the (I) relay closes a circuit from ground on the interrupter contact to battery through the 500 ohm winding of the (CH) relay, operating the relay. The (CH) relay operated, locks through its winding, cam O, to ground on its make contact and armature and when "AV" wiring is furnished, closes a circuit from battery on its make contact for holding the (SL) relay operated. When "W" wiring is furnished, the (SL) relay is held operated from direct battery at cam T in position 11/16-1/4. The (CHG) interrupter is so connected to the circuit that the operation of the (CH) relay is delayed for at least two seconds after the (CS) relay operates. This delay is to prevent the false operation of the (CH) relay should the (CS) relay operate momentarily before the called party answers due to any line disturbances.

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20. Remove Control Charge Call ("F" wiring) (Charge during Conversation)

For calls which are routed to the remote control registration point the sequence switch is set in position 11 or first talking selection position. This position is used so that the (CH) relay will release as the sequence switch advances from position 11, thereby preventing the operation of the subscriber's register after disconnect. The positive potential impulses may be received over the trunk conductors from the remote control registration point at any time after talking selection is completed. These positive impulses cause the 346A tube to breakdown which results in the operation of the (SX) relay. The potentials applied, however, to the tip and ring conductors are so proportioned between the tip and ring as to cause the (CS) relay to hold for the duration of the charge impulse. The Operation of the (SX) relay connects 115 ohm battery to the "H" lead through cam (T) causing the subscriber's line register to operate once for each charge impulse received from the remote control registration point.

21. Non-Zone Overtime Charge Call - "N" Wiring and Figs. 2 & 3 (Charge During Conversation)

Fig. 2 and "N" wiring is used when timing of non-zone messages is required. A Z cam is provided on the sequence switch in order to close the battery circuit to the local timer only in the second talking selection position. When the (CH) relay operates as previously described, a circuit is closed from battery through the (Z) cam to the magnet of the timer. Ground from a make contact of the (CS) relay is connected to the other side of the magnet of the timer. This causes the timer to engage with the drive shaft that is being driven by the telechron motor. This motor, shown in Fig. 3, furnishes the driving power for the timers of 20 district selector circuits. When the (ROT) magnet is energized, contacts 6 and 7 and (CH) function immediately. Contacts 6 and 7 remain closed as long as the magnet is energized and connect ground thru the normally closed contacts (HD) to the (ROT) magnet as a holding circuit for the timing device to guard against the possibility of interference with the timing by release of the (CS) relay due to switchhook flashing by the called party. Contacts (CH) connect battery through resistance (R1) to the "H" lead, operating the message register of the calling subscriber. Contacts (CH) are closed only for a brief interval which is however, sufficiently long to operate the message register and these contacts open as the timing device

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advances from its normal position. Contacts (CH) close once for each interval of 5 minutes and 7 seconds of conversation. As the timer approaches the end of each interval, the (HD) contacts open and the timer will advance to the next timing cycle only if relay (CS) is operated. This insures that charging for any interval will not occur unless both the calling and the called subscribers are still connected to the talking circuit at the start of each interval. If this condition exists the timer will continue its function until the (HD) contacts reclose prior to the start of a new timing interval and from this point on the operation for each overtime interval is the same as described for the initial interval. In this manner the call is metered until disconnection occurs. The circuit is arranged so that no charge occurs after disconnection.

22. Operator Answers

The switch advances to position 13, as described above, and when the operator inserts the plug of an answering cord in the answering jack of the trunk the (CS) relay operates on reverse battery and ground over the trunk. The (CS) relay operated, closes a circuit from ground on cam I, through cam R, to battery through the outer winding of the (L) relay, which operates and advances the switch to position 14. With the switch in position 14, the repeating coil and battery are disconnected and the T and R leads are connected directly to the T and R brushes of the selector through cams P and Q, respectively. As the switch enters position 13 1/2 the (L) relay locks in a circuit from ground over lead S of the selected trunk, through cam E, to battery through the make contact and inner winding of the (L) relay, and in position 13 3/4 the locking circuit through the inner winding of the (D) relay is transferred from the contacts of the (DC) relay to the contacts of cam J. In position 14, a checking tone circuit is closed over the sleeve of the operator's trunk, cam E, make contact of the (L) relay, cam V, 2 mf condenser, cam W, the S brush and terminal at the line finder bank, to ground through the winding of the (CO) relay in the line circuit for number checking.

23. Disconnection - Regular Calls

When the receiver at the calling station is replaced on the switchhook, the (DC) relay releases, in turn releasing the (D) relay. When "V" wiring is furnished, the (D) relay released, closes a circuit operating the (F) relay. The (F) relay operated, disconnects the tip and ring of the trunk

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from the line and closes a circuit from ground on the N commutator brush and segment, through its make contact, contact of cam D, to battery through the R magnet advancing the switch to position 16. When "W" wiring is furnished, the (D) relay releasing, advances the switch to position 16, and the (F) relay does not operate.

24. Message Registering (Charge After Disconnect)

On message rate district circuits, with the switch in position 16, a circuit is closed from battery, make contact of the (CH) relay, cam T, through the (C-1) resistance, H brush and terminal at the line finder bank over lead H, to ground through the message register (MR) operating the message register. During the message registering period, another line finder selector hunting over the line terminals in the same group will not stop its brush on the multiple terminals of this line at this time on account of its (H) relay being shunted by the 5 ohm message register, while the H brush of the hunting selector is passing over the H terminal of the line. When the MR interrupter contacts close, a circuit is closed from ground to battery through the outer winding of the (L) relay, operating the (L) relay. The (L) relay operated, locks through its inner winding and make contact to ground on cam E. Ground on the T make contact of the interrupter is closed through make contact of the (L) relay to battery through the inner winding of the (D) relay, which operates. The (D) relay operated, advances the switch to position 17 thru make contacts of the (L) relay. In position 17 the A cam advances the switch to 18.

When this circuit is arranged to prevent charging in position 16 for talking position 11, the locking path of the (CH) relay is opened between positions 11 and 12, so that on disconnect from position 11, the (CH) relay releases as the switch leaves 11, thereby preventing the operation of the message register.

On flat rate districts, without timed release, per "V" wiring, "A" wiring and apparatus are omitted, the (CH) relay operates direct from the (CS) relay contacts when the called subscriber answers, and ground from the back contact of the (SL) relay advances the switch thru position 16. When "W" wiring is furnished for timed release on flat rate districts, "Y" wiring and apparatus and "J" wiring are also furnished. "Y" wiring and apparatus provides for operation of relay (CH) under control of interrupter (CHG) and relay (I) as covered

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in paragraph 19, while "J" wiring provides a direct ground for operating relays (L) and (D) in position 16. With these relays operated, a circuit is closed for advancing the switch thru position 16.

25. Restoring Line Finder to Normal

As the switch advances from position 16 to 18, the circuits through the (D), (SL), (CH) and (L) relays are opened, releasing the relays and disconnecting battery for operating the message register from lead H. The release of the (SL) relay disconnects battery from lead S, releasing the (CO) relay in the line circuit, thus restoring the line circuit to normal. As the switch enters position 17, the release of the (D) relay closes a circuit operating the (DS) relay. The (DS) relay operated, (a) locks through its make contact and 350 ohm winding, (b) closes a circuit through the outer winding of the (F) relay, this holding the relay operated until the line finder selector has returned to normal and (c) operates the line finder DOWN magnet, from ground on its armature, restoring the line finder selector to normal. When the line finder selector returns to normal, ground is disconnected from the M commutator segment, releasing the (E), (DS) and (MB) relays.

26. Restoring the District to Normal

With the district switch in position 18 a circuit is closed through the district DOWN magnet, which operates and restores the district selector to normal. As the district selector returns to normal, a circuit is closed from ground on the Y commutator brush and segment, cam B to battery through the R magnet, advancing the switch to position 1 or normal. As the switch leaves position 18, the circuit through the DOWN magnet is opened and in position 18 1/4 when "V" wiring is furnished, the circuit through the outer winding of the (F) relay is opened, releasing the relay.

27. Delayed Disconnect

When V wiring is furnished, should the calling subscriber fail to replace the receiver on the switchhook, after the called subscriber has disconnected, the release of the (CS) relay, due to the incoming trunk functioning, operates the selector time alarm circuit from ground through cam I, thereby notifying the switchman of the existing conditions.

When "w" wiring is furnished, should the calling subscriber fail to disconnect, the release of the (CS) relay when the called subscriber hangs up, causes the district release circuit to function and connect ground through the (CS) and (CHO relay contacts and leads 1 and 2 to the (F) relay, which operates, opening the T and R leads and releasing relays (DC) and (D). Relay (D) releasing, advances the switch to position 16.

From this point on, the district is restored to normal as covered in paragraphs 24 and 25.

28. Disconnection Talking to Operator

When the plug of the answering cord is in the trunk jack at the incoming end, ground is connected to the sleeve of the trunk to hold the district (L) relay operated. If the plug of the cord is removed from the trunk jack before the receiver at the calling station is replaced on the switchhook, the line relay in the trunk circuit will operate, thereby holding the ground on the sleeve terminal of the trunk. When the receiver at the calling station is replaced on the switchhook, and the plug of the answering cord is removed from the trunk jack at the incoming end, the (DC) relay releases and ground is disconnected from the sleeve of the trunk, releasing the (L) relay, thus advancing the switch to position 15. As the switch advances from position 14 1/4, the locking circuit through the inner winding of the (D) relay is opened at cam J, releasing the relay. When "V" wiring is furnished, the (D) relay released, opens the circuit through the (SL) relay, which releases and operates the (F) relay, which advances the district switch to position 16 from ground on the N commutator brush and segment. When "W" wiring is furnished, the (D) relay releasing, advances the switch to position 16, the (F) relay is not operated, and the (SL) relay remains operated until the switch passes position 16 1/4. In position 16, with "V" wiring, ground on the armature of the (SL) relay through cam D advances the switch to position 17, the A cam advancing it to position 18. With "W" wiring, the advance of the switch out of position 16 is under control of the (D) and (L) relays and the "MR" interrupter as covered in paragraph 23. In position 16, the (CH) relay being normal, battery is not connected over lead H to operate the message register in the line circuit as the call is not chargeable. From this point on, the line finder and district selectors are restored to normal as described in paragraphs 24 and 25.

29. Disconnection on Abandoned Calls

29.1 Disconnection Before Line Finder Selector Finds Line

Should the calling subscriber replace the receiver on the switchhook before a hunting selector finds the line, the (L) relay in the line circuit releases, removing battery from the H terminals at the multiple bank. The trip and start circuits operate and in turn operate the (LF) relay which starts the selector hunting. The selector will therefore travel to the top of the bank and when the H brush of the selector makes contact with the terminal of the H comb. at the top of the multiple bank, the (H) relay operates. The (H) relay operated, releases the (LF) relay, which in turn releases the (F) relay and opens the circuit through the UP magnet, stopping the selector. The N commutator segment is opened with the selector brushes resting on the "H" comb. terminal to prevent the district switch from advancing from normal when the (F) relay is released by the release of the (LF) relay. With the (F) relay released, the (DS) relay operates from ground on the X commutator brush and segment, through its 1,000 ohm winding. The (DS) relay operates the DOWN magnet, restoring the selector to normal.

29.2 Position 2 to 6

If the receiver at the calling station is replaced on the switchhook while the district switch is in position 2 to 6, the dialing circuit is opened at the calling station, causing the sender circuit to function and connect a direct ground, to the (SC) lead, causing the (D) relay to release on account of the increased current flowing through the outer winding of the relay. The (D) relay is connected differentially, but does not release when its inner winding is connected directly to ground and its outer winding connected to ground in series with a resistance. The (D) relay released, operates the (DS) relay, which restores the line finder selector to normal as described in paragraph 25. The (D) relay released, also opens the circuit through the (SL) relay which releases. The (SL) relay released disconnects battery from lead S, releasing the (CO) relay in the line circuit and advances the district switch to position 6 from ground on the armature and make contact, through the lower contact of cam D. With the district switch in position 6, a circuit is closed from same ground through cam D to battery

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through the DOWN magnet, operating the district DOWN magnet restoring the selector to normal. When the selector reaches normal, ground on the Y commutator brush and segment, advances the switch to normal.

29.3 Position 7 to 10

Should the receiver be replaced on the switchhook while the district switch is in any of these positions, the line finder circuit is restored to normal as described in paragraph 29.2. Trunk hunting and selection beyond will take place in the same manner and the advance of the sender circuit advances the switch to position 10. In position 10, with "V" wiring, the release of the (D) relay operates the (F) relay which closes a circuit from ground on the N commutator brush and segment, advancing the switch to position 16. With "W" wiring, the release of the (D) relay advances the switch direct to position 16, the (F) relay having released when the line finder was restored to normal. The release of the (D) relay also releases the (SL) relay. The (SL) relay released advances the switch to position 17, the A cam advancing it to position 18. From this point on the district switch is restored to normal as described in paragraph 26.

30. Testing Line Finder Selectors

When the 184 plug (shown on the line finder circuit) is inserted in the test jack of the line finder under test, the ST and (ST-1) leads are connected together. The 1000 ohm winding of the (LF) relay is disconnected from the break contact of the (MB) relay and connected to lead Z through the strapped ring and sleeve of the test plug. From this point on the line finder functions as described for a regular call.

31. Telltale - Line Finder Selector with Brushes Normal

31.1 R Wiring

Should the selector travel to the telltale position while hunting, due to the multiple brush not being tripped, the (F) relay remains operated through its outer winding. Ground on the X commutator brush and segment is thereby connected to the lead "To telltale circuit", giving a visual signal to the attendant. As the N commutator segment is open at telltale, the district is prevented from advancing from its normal position. The selector in this case is restored to normal manually by the attendant.

31.2 S Wiring

With the circuit connected per "S" wiring, the (LF) relay releases when the line finder reaches telltale, due to the N and C segments being opened. The release of the (LF) relay releases the UP magnet, and also releases the (F) relay provided a sender has been found. The release of the (F) relay operates the (DS) relay which locks, operates the down drive magnet and reoperates the (F) relay, returning the line finder to normal.

32. Telltale - Line Finder Selector - With Brushes Tripped

Should the selector travel to the telltale position while hunting, with the multiple brush tripped, the circuit is closed from battery in the trip circuit, terminals of the H comb. at the top of the multiple bank, H multiple brush of the line finder selector, cam X, winding of the (H) relay to ground on the armature of the (DS) relay, operating the (H) relay. The (H) relay operated, releases the (LF) relay, which in turn releases the (F) relay and UP magnet. The (F) relay released, opens the circuit through the telltale alarm if furnished and connects ground through the X commutator brush and segment, to battery through the 1,000 ohm winding of the (DS) relay, which operates in turn operating the DOWN magnet restoring the selector to normal.

33. Telltale District Selector

Should the selector travel to the telltale position during brush selection, it will stop in position 8 since the sender does not furnish the 500 ohm ground over the SC lead to operate the (CH) relay. If the district selector goes to telltale during group selection, the district will stick in position 9, since the sender does not furnish the 500 ohm ground to operate the (CH) relay under this condition. In either position, the district will be held with its sender.

34. Overflow

If all the trunks in the group are busy, the district selector while trunk hunting in position 7 will travel to the top of the group and rest on the overflow terminal. As the sleeve terminal at overflow is opened, the (L) relay releases in turn advancing the switch to position 8. With the switch in position 8, the (L) relay operates from ground on the armature of the (CH) relay, advancing the switch to

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position 9. In position 9 a circuit is closed from ground on the Z commutator, brush and segment, through cam K to battery through the R magnet advancing the switch to position 10. In position 10 a circuit is closed from ground on the Z commutator brush and segment through cam K to battery through the 1200 ohm winding of the (L) relay, operating the (L) relay. The (L) relay operated, locks through its 1200 ohm winding and make contact to the same ground, through cam L, advancing the switch to position 14, from ground on cam M. As the switch advances from position 13, the (L) relay releases and in position 14 it advances the switch to position 15. The release of the (L) relay also releases the (CI) relay, disconnecting the sender from the district circuit. With the switch in position 15, the circuit is closed from the miscellaneous tone circuit over lead C to 2 mf condenser, cam G, winding of the repeating coil, 2 mf condenser, cam B, cam J, make contact of the (D) relay to ground on cam I. A tone is therefore induced in the other winding of the repeating coil, thus causing an "all trunks busy" tone to be sent back to the calling subscriber. When the receiver at the calling station is replaced on the switchhook, the (DC) relay releases, opening the locking circuit through the (D) relay, which releases. From this point on, the circuit is restored to normal as described in paragraphs 24, 25 and 26.

35. "O" Commutator

The function of the "O" commutator segment is to maintain an idle condition on the multiple overflow terminal so that more than one selector may stop on overflow at one time, otherwise the first selector reaching overflow will make the sleeve multiple terminals busy, thus causing the succeeding selectors to continue upward into the next group of trunks. The O commutator segment is opened at overflow but the S bar is continuous. Both the O and S commutator brushes are permanently strapped together and are wired to the multiple sleeve brush. When the selector is at overflow, the O commutator brush is resting on an open (dead) segment and as the busy ground is fed through the O commutator bar only, this arrangement maintains a nonbusy condition on the sleeve terminals. When necessary to combine two or more groups of trunks, the multiple sleeve overflow terminals between

the combined groups are made permanently busy by being connected to ground. AS the S commutator bar is closed at overflow, the (L) relay is held operated, at this time, and the selector therefore hunts past the "made busy" terminals into the next group.

36. Contact Protection

Condenser (P) and resistance (ST) are furnished for the protection of the contacts of the (SS) stepper magnet.

37. Selector Group Register

As the sequence switch passes through position 7 1/2 ground through the contacts of the (SL) relay operates the selector group register on calls which are not abandoned before position 7 1/2 is reached. This register records the number of calls handled by a group of districts.

38. Overflow Register

On district overflow, ground from the "Z" segment in position 14 1/2 operates the overflow register thru the multiple brush and "T" overflow terminal.

BELL TELEPHONE LABORATORIES, INC.

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